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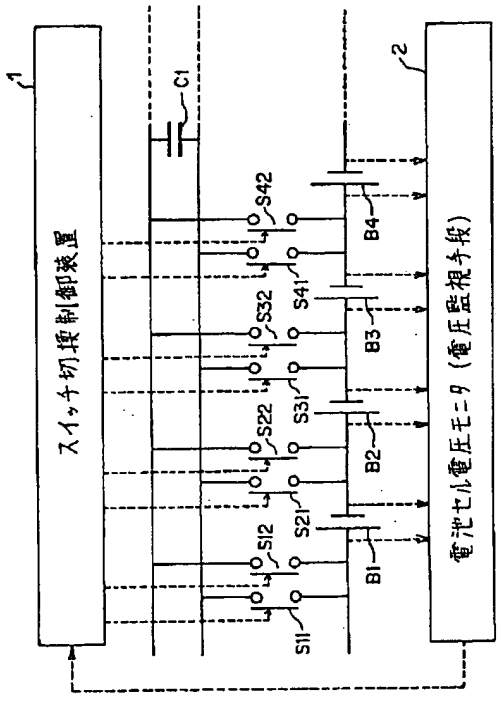
(54)【発明の名称】　蓄電装置

(57)【要約】

【課題】　蓄電装置において、電気エネルギの浪費を防止しながら、コストを抑制しうる簡素な構成でしかも速やかに、満充電ではない状態においても蓄電手段の電圧の均衡化を行なうことができるようにする。

【解決手段】　複数の蓄電手段Ｂ１～Ｂ４のうちの少なくともいずれか２つに並列接続可能な蓄電器Ｃ１と、蓄電器Ｃ１を複数の蓄電手段Ｂ１～Ｂ４のうちの第１の蓄電手段に接続してこの第１の蓄電手段を通じて蓄電器Ｃ１の充電又は放電を行なう第１の接続モードと蓄電器Ｃ１を第１の蓄電手段とは異なる第２の蓄電手段に接続してこの第２の蓄電手段を通じて蓄電器Ｃ１の充電又は放電を行なう第２の接続モードとを選択的に切り換える接続切換手段Ｓ１１～Ｓ４２とをそなえ、接続切換手段Ｓ１１～Ｓ４２による第１及び第２の接続モードの切り換えを繰り返して行なうように構成して、蓄電手段Ｂ１～Ｂ４の電圧を均衡化する。



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【特許請求の範囲】
【請求項１】　複数の蓄電手段を直列に接続されて構成された蓄電装置において、
上記複数の蓄電手段のうちの少なくともいずれか２つに並列接続可能な蓄電器と、
上記蓄電器を上記複数の蓄電手段のうちの第１の蓄電手段に接続して該第１の蓄電手段を通じて該蓄電器の充電又は放電を行なう第１の接続モード、及び、上記蓄電器を上記第１の蓄電手段とは異なる第２の蓄電手段に接続して該第２の蓄電手段を通じて該蓄電器の充電又は放電を行なう第２の接続モードを選択的に切り換える接続切換手段とをそなえ、
該接続切換手段による上記の第１及び第２の接続モードの切り換えが繰り返して行なわれるように構成されたことを特徴とする、蓄電装置。
【請求項２】　複数の蓄電手段を直列に接続されて構成された蓄電装置において、
上記複数の蓄電手段にそれぞれ並列接続可能な蓄電器と、
上記複数の蓄電手段のそれぞれの電圧を監視する電圧監視手段と、
上記電圧監視手段の電圧監視結果に応じて上記複数の蓄電手段の中から２つの蓄電手段を選択してこれらの２つの蓄電手段のうちの第１の蓄電手段に接続して該第１の蓄電手段を通じて該蓄電器の充電又は放電を行なう第１の接続モード、及び、上記蓄電器を上記第１の蓄電手段とは異なる第２の蓄電手段に接続して該第２の蓄電手段を通じて該蓄電器の充電又は放電を行なう第２の接続モードを選択的に切り換える接続切換手段とをそなえ、
該接続切換手段による上記の第１及び第２の接続モードの切り換えが繰り返して行なわれるように構成されたことを特徴とする、蓄電装置。
【請求項３】　上記接続切換手段は、上記電圧監視手段の電圧監視結果に応じて互いに電圧差の大きい２つの蓄電手段を上記の第１及び第２の蓄電手段として選択することを特徴とする、請求項２記載の蓄電装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、多数の蓄電池を直列接続し組電池として構成された蓄電装置に関し、特に、電気自動車に用いて好適の、蓄電装置に関する。
【０００２】
【従来の技術】近年、電気自動車の実用性向上のための技術開発が進められているが、現在の電気自動車の電源としては、多数の蓄電池（以下、バッテリという）を直列接続したもの（組電池）を使用している。このように多数の蓄電池を直列接続した組電池の場合、組電池の出力は、最も低い電圧の電池に依存するため、各電池を均等に使用することができず、各電池の能力を最大限に発揮させることができない。

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【０００３】ところで、リチウムイオン電池のように、放電量に依存して出力電圧が決定されるもの（図４参照）では、各電池の電圧を等しくすることで、各電池の放電量（逆に言うと、充電量又は残存容量）を等しくすることができ、各電池の電圧が等しくなるように調整しながら、充電を行なうようにすればよい。そこで、蓄電池（バッテリ）の電圧均衡化回路が従来から提供されており、図５に示すように構成されている。
【０００４】図５に示す回路は、組電池の電圧均衡化回路の１セル分（あるいは１モジュール分）を抜粋したものであり、各バッテリに同回路が装備される。そして、このような回路をそなえた状態での充電動作が行なわれるが、充電動作の末期に該回路による放電動作が行なわれる。すなわち、充電の進行によりバッテリ１０１の端子電圧が上昇するが、この状態を電圧監視回路（電圧検出回路）１０４が監視しており、セルの両端電圧ＶＢが設定電圧以上になった場合に放電スイッチ１０２をオン状態（閉状態）に移行させる。
【０００５】これにより、放電抵抗器１０３への通電が行なわれ、電気エネルギが熱に変換されることにより消費される。この消費により、セル電圧ＶＢが設定電圧以下の電圧になれば、放電スイッチ１０２をオフ状態（開状態）に移行させることが行なわれる。このような放電スイッチ１０２のオン，オフが繰り返されることにより、バッテリセルの電圧ＶＢは、設定電圧に調整される。
【０００６】なお、実際の回路では、放電スイッチ１０２の代わりにパワートランジスタ等の電力素子を使用し、オンオフ制御ではなく、リニア制御により電圧を調整する等の方法が一般的である。
【０００７】
【発明が解決しようとする課題】しかしながら、従来の蓄電装置では、種々の課題がある。すなわち、上述の回路による場合、設定電圧を超過したエネルギが放電抵抗器１０３により熱の形で浪費されてしまう。このため、電力損失が大きくなるとともに、放熱対策を考慮しなければならないことが大きな問題となる。
【０００８】また、充電の末期のセル電圧ＶＢが上昇した場合にだけ均衡化が可能であり、放電時や車両を使用していない間の空き時間などを利用した電圧均衡化を行なえないという課題がある。したがって、ハイブリッド電気自動車のように発電走行時に満充電まで充電しないものには利用できない。
【０００９】さらに、放電抵抗器や放熱板およびスイッチング用の素子など大容量のものを使用しなければならず、装置が大型化したり、放熱のために冷却装置が必要になるなど構造が単純にならないという課題もある。そこで、放電方式ではない均衡化回路が必要であり、その一例として特開平６－３１９２８７号公報の技術が提供されている。

【００１０】この技術は、直列接続された組電池の両端にコンデンサを接続して、各バッテリセル（充電単電池）を略均一に充電するものであるが、大容量コンデンサが必要であり、各バッテリセルの端子電圧を検出しながら所要の充電対象となるバッテリセルを選択する制御は制御ロジックが複雑である。そこで、直列に接続されたバッテリに対して、各バッテリと対応した数のコンデンサを設け、各コンデンサを対応したバッテリとそれぞれ並列接続させる第１の接続モードと、上記の各コンデンサを対応するバッテリに隣接したバッテリとそれぞれ並列接続させる第２の接続モードとを交互に切り換えるようにすることで、各バッテリの電圧の均衡化を図ることが考えられる。

【００１１】この場合は、コンデンサを介して電荷をバッテリ間で移動させることにより、各バッテリの電圧が均衡化されるのである。しかしながら、このような構成では、隣り合うバッテリ間でしか電荷の移動を行なうことができないため、バッテリのセル数が多くなるのにしたがって、電圧の均衡化に時間かかかってしまうという課題かある。また、バッテリセル毎にコンデンサが必要となるため、電圧均衡化回路が大きくなってしまい、コスト高を招くという課題もある。

【００１２】ところで、特開平６－３１９２８７号公報には、複数のバッテリセルを直列接続してなる組電池に、回生電流より充電されたコンデンサにより充電を行なう際に、各バッテリセルの端子電圧とコンデンサ電圧とを監視しながら、充電するバッテリセルを選択する技術が開示されている。この技術では、充電するバッテリセルの端子電圧の総和がコンデンサ電圧よりも低くなるように複数のバッテリセルの中から一部を選択して充電することで、コンデンサの電圧が低下していても充電を可能にすると共に、端子電圧の低いバッテリセルを充電することで、複数のバッテリセルを均一に充電できるようにしている。

【００１３】この技術は、バッテリの充電に際して各バッテリの電圧を均一化することはできるが、バッテリの充電時以外にバッテリの電圧均衡化を図ることはできない。しかしながら、一般的なバッテリの電圧均衡化に利用可能な技術である。本発明は、上述の課題に鑑み創案されたもので、電気エネルギの浪費を防止しながら、コストを抑制しうる簡素な構成でしかも速やかに、満充電ではない状態においても蓄電手段の電圧の均衡化を行なうことができるようにした、蓄電装置を提供することを目的とする。

【００１４】

【課題を解決するための手段】このため、請求項１記載の本発明の蓄電装置では、接続切換手段が、第１の接続モード及び第２の接続モードの切り換えを行ない、第１の接続モードが選択されると、蓄電器を複数の蓄電手段のうちの第１の蓄電手段に接続してこの第１の蓄電手段

を通じて蓄電器の充電又は放電を行ない、蓄電器の電圧と第１の蓄電手段の電圧とが接近するようになり、第２の接続モードが選択されると、蓄電器を第１の蓄電手段とは異なる第２の蓄電手段に接続してこの第２の蓄電手段を通じて蓄電器の充電又は放電を行ない、蓄電器の電圧と第２の蓄電手段の電圧とが接近するようになる。したがって、接続切換手段により、第１の接続モード及び第２の接続モードの切り換えが繰り返して行なわれると、蓄電器を介して第１の蓄電手段と第２の蓄電手段との間で電圧が均衡化されていく。

【００１５】請求項２記載の本発明の蓄電装置では、電圧監視手段が複数の蓄電手段のそれぞれの電圧を監視して、接続切換手段が電圧監視手段の電圧監視結果に応じて複数の蓄電手段の中から２つの蓄電手段を選択してこれらの２つの蓄電手段の間で第１の接続モード及び第２の接続モードの切り換えを行なう。第１の接続モードが選択されると、蓄電器を複数の蓄電手段のうちの第１の蓄電手段に接続してこの第１の蓄電手段を通じて蓄電器の充電又は放電を行ない、蓄電器の電圧と第１の蓄電手段の電圧とが接近するようになり、第２の接続モードが選択されると、蓄電器を第１の蓄電手段とは異なる第２の蓄電手段に接続してこの第２の蓄電手段を通じて蓄電器の充電又は放電を行ない、蓄電器の電圧と第２の蓄電手段の電圧とが接近するようになる。したがって、接続切換手段により、第１の接続モード及び第２の接続モードの切り換えが繰り返して行なわれると、蓄電器を介して電圧監視結果に応じて選択された第１の蓄電手段と第２の蓄電手段との間で電圧が均衡化されていく。

【００１６】請求項３記載の本発明の蓄電装置では、接続切換手段が電圧監視手段の電圧監視結果に応じて、複数の蓄電手段の中から互いに電圧差の大きい２つの蓄電手段を第１及び第２の蓄電手段として選択して電圧の均衡化を行なうので、電圧差の大きい２つの蓄電手段の電圧が均衡化され、このような処理の繰り返しにより、複数の蓄電手段の電圧均衡化が促進されていく。

【００１７】

【発明の実施の形態】以下、図面により、本発明の実施の形態について説明すると、図１～図４は本発明の一実施形態としての蓄電装置を示すものである。図１に示すように、本蓄電装置では、複数の蓄電手段としての蓄電池（二次電池、以下、バッテリ又はバッテリセルともいう）Ｂ１，Ｂ２，Ｂ３，Ｂ４，・・・が直列に接続された組電池として構成されている。

【００１８】特に、本実施形態の蓄電装置は、電気自動車用電源として用いられる組電池（＝複数の蓄電池を接続してなる電池）に適用しうるものであり、数十個のバッテリセルを直列に接続した組電池として構成されている。なお、図１では図面の都合上、４個のバッテリセルのみを示しているが、図示しない多数のバッテリセルがさらに接続されており、全部で数十個のバッテリセルが

直列に接続されているものとする。

【００１９】ただし、本蓄電装置では、組電池を構成するバッテリセル（蓄電手段）の数は特に限定されるものではない。このようなバッテリセル（蓄電手段）Ｂ１，Ｂ２，Ｂ３，Ｂ４，・・・の各端子には、それぞれ２つずつのスイッチが接続されている。つまり、図１に示すように、バッテリセルＢ１のプラス端子側にはスイッチＳ１１，Ｓ１２の各一端が接続され、バッテリセルＢ１のマイナス端子側（即ち、バッテリセルＢ２のプラス端子側）にはスイッチＳ２１，Ｓ２２の各一端が接続され、バッテリセルＢ２のマイナス端子側（即ち、バッテリセルＢ３のプラス端子側）にはスイッチＳ３１，Ｓ３２の各一端が接続され、バッテリセルＢ３のマイナス端子側（即ち、バッテリセルＢ４のプラス端子側）にはスイッチＳ４１，Ｓ４２の各一端が接続されている。図示しないバッテリセルの端子についても同様にスイッチが接続されている。

【００２０】このようなスイッチＳ１１，Ｓ１２～Ｓ４１，Ｓ４２，・・・は、いずれもオン・オフスイッチであり、スイッチＳ１１，Ｓ１２～Ｓ４１，Ｓ４２，・・・のうち、スイッチＳ１１，Ｓ２１，Ｓ３１，Ｓ４１，・・・の各他端は、蓄電器（コンデンサ）Ｃ１の一端側に接続されており、スイッチＳ１２，Ｓ２２，Ｓ３２，Ｓ４２，・・・の各他端は、コンデンサＣ１の他端側に接続されている。そして、これらのスイッチＳ１１，Ｓ１２～Ｓ４１，Ｓ４２，・・・をオン・オフ制御するために、スイッチ切換制御装置１がそなえられている。

【００２１】また、各バッテリセルＢ１，Ｂ２，Ｂ３，Ｂ４，・・・の端子電圧を監視する電圧監視手段としてのバッテリセル電圧モニタ２がそなえられており、このバッテリセル電圧モニタ２の監視により得られた各バッテリセルＢ１，Ｂ２，Ｂ３，Ｂ４，・・・の端子電圧情報はスイッチ切換制御装置１に送信されるようになっている。

【００２２】スイッチ切換制御装置１では、スイッチＳ１１，Ｓ１２～Ｓ４１，Ｓ４２，・・・の中の任意のスイッチを接続させることができるが、ここでは、バッテリセル電圧モニタ２からの電圧情報に基づいて最も電圧の高いバッテリセルと最も電圧の低いバッテリセルとの間で、電圧を均衡化させるためのスイッチ切換処理を行なうようになっている。

【００２３】すなわち、スイッチ切換制御装置１では、スイッチ切換処理により、まず、最も電圧の高いバッテリセルとコンデンサＣ１とを並列接続して（このような接続状態を、第１の接続モードという）、次に、この最も電圧の高いバッテリセルとコンデンサＣ１との並列接続を遮断した上で、最も電圧の低いバッテリセルとコンデンサＣ１とを並列接続して（このような接続状態を、第２の接続モードという）、その後、この最も電圧の低いバッテリセルとコンデンサＣ１との並列接続を遮断する。

【００２４】なお、各バッテリセルをコンデンサＣ１に接続する際に、各バッテリセルのプラス端子をコンデンサＣ１の一端側に、各バッテリセルのマイナス端子をコンデンサＣ１の他端側にというように、端子方向を合わせて接続することは勿論のことである。このような処理を行なうと、第１の接続モードでは、コンデンサＣ１に高い電圧が加えられるためこの高い電圧に応じた多量の電荷が蓄えられて、第２の接続モードでは、コンデンサＣ１に加わる電圧は第１の接続モードよりも低くなりこき電圧低下に応じた電荷が最も電圧の低いバッテリセルに移送される。したがって、第１の接続モードと第２の接続モードとを繰り返すことで、最も電圧の高いバッテリセルから最も電圧の低いバッテリセルへ電荷が移送され、これらバッテリセル間で電圧の均衡化が行なわれるのである。

【００２５】本実施形態のスイッチ切換制御装置１では、所定の周期で、その時点で最も電圧の高いバッテリセルと最も電圧の低いバッテリセルとを選択して、選択したバッテリセルを適宜コンデンサＣ１と並列接続させて、第１の接続モードと第２の接続モードとを実行しながら、これらのバッテリセル間で、電圧の高いバッテリセルから電圧の低いバッテリセルへ電荷を移送してバッテリセル間での電圧の均衡化を行なうようになっている。

【００２６】なお、１周期内で、第１の接続モードと第２の接続モードとを所定数回繰り返すように構成してもよく、第１の接続モードと第２の接続モードとをそれぞれ１回だけ行なうように構成してもよい。いずれにしても、このような第１の接続モードと第２の接続モードとによるバッテリセルとコンデンサＣ１との並列接続により、その時点で最も電圧の高いバッテリセルと最も電圧の低いバッテリセルとの間で電圧の均衡化が行なわれるようになっているのである。

【００２７】なお、接続切換手段としてのスイッチＳ１１，Ｓ１２～Ｓ４１，Ｓ４２，・・・は、機械的なスイッチＳ１１～Ｓ１４で構成してもよいが、制御性や耐久性を考慮すると、トランジスタ等の半導体素子による半導体切換手段（半導体スイッチ）により構成することが考えられる。本発明の一実施形態としての蓄電装置は、上述のように構成されているので、次のような動作が行なわれる。

【００２８】つまり、スイッチ切換制御装置１では、電圧監視手段としてのバッテリセル電圧モニタ２からの電圧情報に基づいて、複数のバッテリセルの中から最も電圧の高いバッテリセルと最も電圧の低いバッテリセルとを周期的に選択して、これらの最も電圧の高いバッテリセルと最も電圧の低いバッテリセルとの間で、電圧を均衡化させるためのスイッチ切換処理を行なう。

【００２９】例えばある処理周期で、バッテリセルＢ１

の電圧Ｖ１が最も電圧が高く、バッテリセルＢ３の電圧Ｖ３（Ｖ１＜Ｖ３）が最も電圧が低い場合には、まず、図２に示すように、スイッチＳ１１とスイッチＳ２２とをオン（接続）状態にして、バッテリＢ１のプラス側端子をコンデンサＣ１の一端側（図１，図２，図３中、の下方の端子側）に接続させると共に、バッテリＢ１のマイナス側端子をコンデンサＣ１の他端側（図１，図２，図３中、の上方の端子側）に接続させる（第１の接続モード）。

【００３０】この第１の接続モードのように、コンデンサＣ１とバッテリセルＢ１とが並列接続されると、バッテリセルＢ１の電圧及びコンデンサＣ１の電位差はいずれもＶ１′となる。このＶ１′は、バッテリセルＢ１からコンデンサＣ１へ流入した電荷に応じた分v_1だけＶ１よりも低い電圧（＝Ｖ１－v_1）である。次に、図１に示すように、スイッチＳ１１とスイッチＳ２２とをオフ（遮断）状態に戻してから、図３に示すように、スイッチＳ３１とスイッチＳ４２とをオン（接続）状態にして、バッテリＢ３のプラス側端子をコンデンサＣ１の一端側に接続させると共に、バッテリＢ３のマイナス側端子をコンデンサＣ１の他端側に接続させる（第２の接続モード）。

【００３１】この第２の接続モードのように、コンデンサＣ１とバッテリセルＢ３とが並列接続されると、バッテリセルＢ３の電圧及びコンデンサＣ１の電位差はそれぞれＶ３′となる。このＶ３′は、バッテリセルＢ３からコンデンサＣ１へ流入した電荷分v_3だけＶ３よりも高い電圧（＝Ｖ３＋v_3）である。また、第２の接続モードの終了時にも、図１に示すように、スイッチＳ３１とスイッチＳ４２とをオフ（遮断）状態に戻す。

【００３２】このようにして、コンデンサＣ１を介して、バッテリセルＢ１からバッテリセルＢ３へ電荷が移送されてバッテリセルＢ１の電圧はＶ１から減少し、バッテリセルＢ３の電圧はＶ３から増加して、これらのバッテリセルＢ１とバッテリセルＢ３との電圧差は減少する。このようなバッテリセルＢ１とバッテリセルＢ３との間で、第１の接続モードによるスイッチ制御と第２の接続モードによるスイッチ制御とを所定回数又は１回だけ行なうと、次の処理周期に移り、スイッチ切換制御装置１では、再びバッテリセル電圧モニタ２からの電圧情報に基づいて、複数のバッテリセルの中から最も電圧の高いバッテリセルと最も電圧の低いバッテリセルとを選択する。

【００３３】ここでは、バッテリセルＢ１の電圧が減少しバッテリセルＢ３の電圧が増加しているが、これらの電圧の増加や減少が少なければ、最も電圧の高いバッテリセルとしてバッテリセルＢ１が選択されたり、最も電圧の低いバッテリセルとしてバッテリセルＢ３が選択されたりすることもあり得るが、少なくとも、前回の処理周期に比べて、最も電圧の高いバッテリセルの電圧は低くなっており、最も電圧の低いバッテリセルの電圧は高くなっている。

【００３４】そして、上述と同様に、新たに選択した最も電圧の高いバッテリセルと最も電圧の低いバッテリセルとの間で、第１の接続モードによるスイッチ制御と第２の接続モードによるスイッチ制御とを所定回数又は１回だけ行なうことで、これらのバッテリセル間での電圧の均衡化を行なう。この結果、やはり、前回の処理周期に比べて、最も電圧の高いバッテリセルの電圧は低くなり、最も電圧の低いバッテリセルの電圧は高くなる。

【００３５】このような処理を繰り返すことで、複数のバッテリセル間での電圧の均衡化が効率よく行なわれるようになって、複数のバッテリセルにおいて速やかに電圧が均衡化されるようになるのである。特に、２つのバッテリセル間の電圧差が大きいほど、バッテリセルからコンデンサＣ１への電荷の移動が速やかに行なわれ、２つのバッテリセル間での電荷の移動による電圧均衡化が短時間で行なわれるようになるため、電圧の均衡化が効率よく行なわれるのである。

【００３６】なお、上述の実施形態では、最もシンプルな例として、各処理周期で最も電圧の高いバッテリセル及び最も電圧の低いバッテリセルの２つのバッテリセル間での電圧均衡化を行なうものとしているが、３つ以上の多数のバッテリセル間での電圧均衡化を同時に行なうようにしてもよい。例えば、全てのバッテリセルの平均電圧を算出して、電圧がこの平均電圧よりも所定電圧差以上高いバッテリセル群（単数又は複数のバッテリセル）と、電圧がこの平均電圧よりも所定電圧差以上低いバッテリセル群（単数又は複数のバッテリセル）との間で、同時に電圧均衡化を行なうように構成することが考えられる。

【００３７】この場合、まず、平均電圧よりも所定電圧差以上高いバッテリセル群の各バッテリセルを同時にコンデンサＣ１に並列接続して（第１の接続モード）、コンデンサＣ１を充電し、次いで、これらの接続を解除した上で、平均電圧よりも所定電圧差以上低いバッテリセル群の各バッテリセルを同時にコンデンサＣ１に並列接続して（第２の接続モード）、コンデンサＣ１から電圧の低い各バッテリセルへ放電させる。これにより、電圧の高い各バッテリセルから電圧の低い各バッテリセルへと電荷が移動して、多数（３個以上）のバッテリセル間で同時に電圧均衡化を行なうことができ、多数のバッテリセル間でより速やかに電圧均衡化を行なうことができる利点がある。

【００３８】また、全てのバッテリセルの平均電圧に対して、いずれのバッテリセルの電圧もこの平均電圧に対して所定電圧差（微小値）以内になった時点で、電圧均衡化処理を終了するように設定すれば、より効率よく電圧均衡化処理を行なうことができる。もちろん、さらに蓄電池を使用していくうちに、いずれかのバッテリセル

の電圧が平均電圧に対して所定電圧差（微小値）以上になったら、例えば最も電圧差のあるバッテリセル間で電圧均衡化処理を行なうようにすればよい。

【００３９】このように、本蓄電装置では、多数のバッテリセル（充電手段）の中から任意のものを選んで、これをコンデンサに接続して電圧均衡化処理を行なうことができるので、バッテリセルを適切に選択して電圧均衡化処理すれば、極めて効率よく電圧均衡化処理を行なうことができるのである。また、電荷移動部品が１つのバランスコンデンサＣ１だけで済むため、回路を小さく構成することができ、コストも低減することができる利点もある。

【００４０】ところで、本蓄電装置にかかる蓄電池は例えばリチウムイオン電池で形成されており、図４に示すリチウムイオン電池の特性のように、電圧が放電量に依存して決定される。逆に言えば、バッテリ電圧は充電量（蓄電量）に依存して決定されるともいえる。したがって、かかる電圧の均衡化により、所望の放電量、即ち、充電量（蓄電量）の状態に調整されることになる。

【００４１】なお、図４中に示すニッケル水素電池の特性のように、放電量に対し電圧が一意に定まらない平坦な特性の蓄電池では、電圧の均衡化により放電量（充電量）が所望の状態にならないが、上記のリチウムイオン電池のように放電量に対し電圧が一意に定まるものでは、組電池の各バッテリセルの放電量（充電量）が所望の状態に均一化されるため、かかる電池（例えばリチウムイオン電池）の性能をフルに活用することができるようになる。

【００４２】もちろん、本装置では、コンデンサＣ１を介して電荷を移動させることにより各バッテリセルＢ１，Ｂ２，Ｂ３，Ｂ４，・・・の電圧を均衡化するため、大きな発熱要素が存在せず、発熱によるエネルギ損失を回避した状態での均衡化が実現される。また、組電池への満充電までの充電中に限らず、走行中，充電中，放電中など使用状況にとらわれることなく、すべての状態で均衡化の動作を行なうことができるため、放電中や電池未使用時等においても均衡化の動作を行なわせることができる。もちろん、ハイブリッド電気自動車のように発電走行時に満充電まで充電しないものにも利用することができる。

【００４３】なお、このような回路を実際に適用する場合には、効率がよく動作が確実で耐久性のよいことが必要となるが、このような具体的条件を考慮すると、スイッチＳ１１，Ｓ１２，Ｓ２１，Ｓ２２，・・・には電力素子（ＦＥＴあるいはＩＧＢＴ）等のスイッチングロスが極力小さなものを使用し、スイッチ切換制御装置１に外部発振回路等により自動的にスイッチＳ１１，Ｓ１２，Ｓ２１，Ｓ２２，・・・の切り換え動作を行なわせる回路を装備することが好ましい。

【００４４】また、コンデンサＣ１には比較的容量の大

きなコンデンサ、例えば電気二重層コンデンサを用いれば速やかな電圧の均衡化を行なえるが、例えば常時又は頻繁にこのような電圧の均衡化制御を行なうようにすれば、小容量のコンデンサを用いても実用上十分に電圧の均衡化による充電量の均衡化を行なうことができる。さらに、コンデンサＣ１への突入電流の防止回路や初期充電回路も必要と考えられる。

【００４５】また、スイッチ切換制御装置１については、上述のようなスイッチ切り換えの動作以外に、メンテナンスを行なう時に用いるメンテナンススイッチと各スイッチＳ１１，Ｓ１２，Ｓ２１，Ｓ２２，・・・とを連動させるようにしたり、外部の電圧測定回路などにより必要が生じた場合に駆動する方法や、電圧均衡化処理（各スイッチＳ１１，Ｓ１２，Ｓ２１，Ｓ２２，・・・を選択して適宜接続する処理）を、車両不使用時に行なうようにする方法や、タイマー回路などで一定時間ごとに行なう方法や、接続される電気負荷の制御回路等（電気自動車の場合は、モータコントローラや残存容量計など）からの均衡化指示を受けた場合に行なう方法などのさまざまな組み合わせが考えられる。

【００４６】さらに、蓄電器としてのコンデンサＣ１に代えて、絶縁トランスやバッテリセルを用いるようにしても、ほぼ同様な効果を得ることができる。また、本蓄電装置は、蓄電手段としてバッテリに代えてコンデンサ（蓄電器）を用いるようにした組蓄電器にも適用しうるものである。つまり、複数の直列接続された蓄電池（バッテリ）からなる組電池に代えて、複数の直列接続された蓄電器（コンデンサ）からなる組蓄電器に適用することも考えられる。

【００４７】そして、組電池状態又は組蓄電器状態にした場合にセル電圧のばらつきによる各種不具合が顕著化しやすいバッテリや電気二重層コンデンサなどについて上述の構造を採用し、電圧均衡化回路を構成すれば、大きなエネルギ損失の発生なしに常時電圧の均衡化を行なえるシステムを実現できるようになる。本回路の作動を常時ではなく、バッテリセル電圧モニタなどにより、任意の必要な時期に電圧を均衡化する方法等を具現化することができる。

【００４８】特に、リチウムイオン電池に本回路を適用することにより、リチウムイオン電池の能力を１００パーセント引き出した上での、安全性の確保が容易になる。なお、セル電圧のアンバランスが大きい場合から小さくなった場合に移行するに従い、制御手段による接続モード切り換えの速度を変化させることにより、電圧均衡化の所要時間を短縮させることもできる。

【００４９】

【発明の効果】以上詳述したように、請求項１記載の本発明の蓄電装置によれば、接続切換手段により、第１の接続モード及び第２の接続モードの切り換えが繰り返して行なわれると、蓄電器を介して第１の蓄電手段と第２

の蓄電手段との間で電圧が均衡化されていくため、アンバランス電圧分を放熱による電力消費で浪費させるようなことなく、電力損失を抑制しながら電圧均衡化を行なうことができる利点があり、組電池としての能力を効率良く発揮しうるようになる。また、放熱損失の低減により放熱対策を軽減化しうるという付加的な利点も得ることができる。もちろん、走行中，充電中，放電中など使用状況にとらわれることなく電圧の均衡化を行なうことができるようになる利点がある。

【００５０】請求項２記載の本発明の蓄電装置によれば、接続切換手段により、第１の接続モード及び第２の接続モードの切り換えが繰り返して行なわれると、蓄電器を介して電圧監視結果に応じて選択された第１の蓄電手段と第２の蓄電手段との間で電圧が均衡化されていくため、電圧状態に応じて均衡化の要求度の高い蓄電手段を選択して効率よく速やかに電圧の均衡化を行なうことができるようになり、組電池としての能力を効率良く発揮しうるようになる。もちろん、アンバランス電圧分を放熱による電力消費で浪費させるようなことなく、電力損失を抑制しながら電圧均衡化を行なうことができる利点や、放熱損失の低減により放熱対策を軽減化しうるという付加的な利点や、走行中，充電中，放電中など使用状況にとらわれることなく電圧の均衡化を行なうことができるようになる利点もある。

【００５１】請求項３記載の本発明の蓄電装置によれば、電圧差の大きい蓄電手段から効率よく電圧の均衡化を進めることができ、複数の蓄電手段における電圧の均衡化を速やかに行なうことができ、組電池としての能力を速やかに効率良く発揮しうるようになる。

【図面の簡単な説明】

【図１】本発明の一実施形態としての蓄電装置の要部構成を示す回路図である。

【図２】本発明の一実施形態としての蓄電装置の動作を説明するための図１に対応した回路図であり、図１とは異なる動作態様を示す図である。

【図３】本発明の一実施形態としての蓄電装置の動作を説明するための図１，図２に対応した回路図であり、図１，図２とは異なる動作態様を示す図である。

【図４】本発明の一実施形態としての蓄電装置における電池の特性を示すグラフである。

【図５】従来の蓄電装置を示す模式的回路図である。

【符号の説明】

１　スイッチ切換制御装置

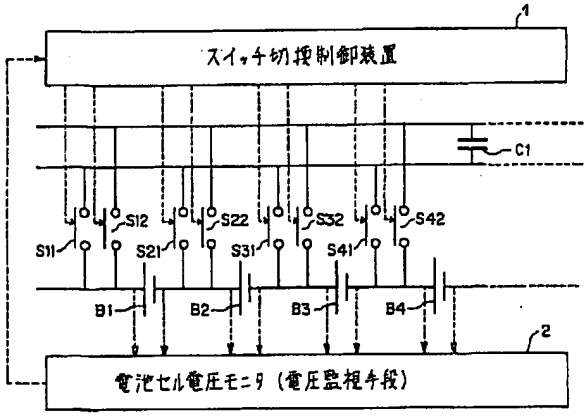
２　電圧監視手段としてのバッテリセル電圧モニタ

Ｂ１～Ｂ４　蓄電手段としての蓄電池（二次電池）を構成するバッテリセル

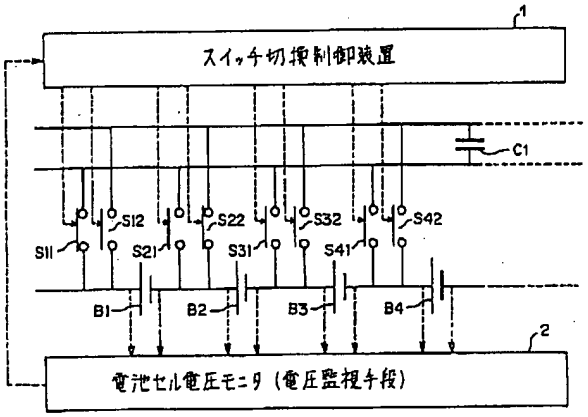
Ｃ１～Ｃ４　蓄電器（コンデンサ）

Ｓ１１～Ｓ４１，Ｓ１２～Ｓ４２　接続切換手段としてのスイッチ

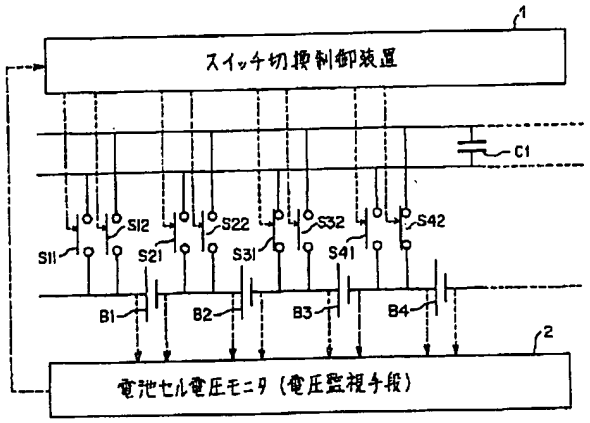
【図１】



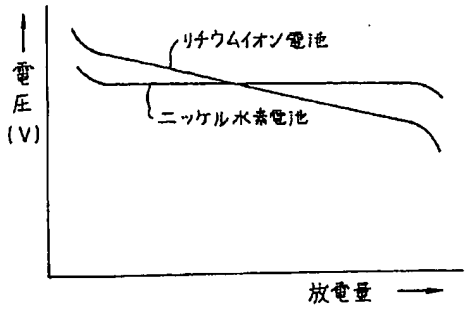
【図２】



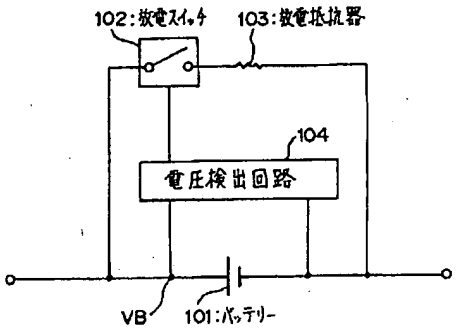
【図３】


スイッチ切換制御装置
1
C1
S11
S12
S21
S22
S31
S32
S41
S42
B1
B2
B3
B4
2
電池セル電圧モニタ（電圧監視手段）

【図４】


電圧
(V)
リチウムイオン電池
ニッケル水素電池
放電量

【図５】


102:放電スイッチ
103:放電抵抗器
104
電圧検出回路
VB
101:バッテリー

PATENT ABSTRACTS OF JAPAN

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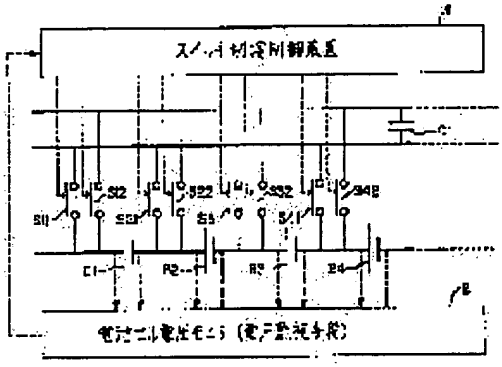
(72)Inventor : SHINPO TOSHIYA
SUZUKI HIROYASU

(54) STORAGE APPARATUS



(57)Abstract:
PROBLEM TO BE SOLVED: To allow a storage apparatus to balance the voltages of storage means even in a not fully charged state with such a simple construction as to reduce costs as well as quickly, while preventing the waste of electrical energy.
SOLUTION: A storage apparatus comprises a capacitor C1 that can be connected in parallel with at least two of a plurality of storage means B1 to B4, and connection switching means S11 to S42 for selectively switching a first connection mode and a second connection mode. The first connection mode is a mode for connecting the capacitor C1 to a first one of the plurality of condensing means B1 to B4, and charging or discharging the capacitor C1 via the first storage means. The second connection mode is a mode for connecting the capacitor C1 to a second storage means other than the first storage means, and charging or discharging the capacitor C1 via the second storage means. It is designed so that the means S11 to S42 can repeat the switching operation between the first and the second connection modes so as to balance the voltages of the storage means B1 to B4.

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1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] In the accumulation-of-electricity equipment which two or more accumulation-of-electricity means were connected to the serial, and was constituted The capacitor of two or more above-mentioned accumulation-of-electricity means in which parallel connection is possible to any two at least, the above-mentioned capacitor -- the 1st accumulation-of-electricity means of two or more above-mentioned accumulation-of-electricity means -- connecting -- this -- the 1st connection mode which performs charge or discharge of this capacitor through the 1st accumulation-of-electricity means -- The connection means for switching which switches alternatively the 2nd connection mode which performs charge or discharge of this capacitor through the 2nd accumulation-of-electricity means is offered. and the 2nd accumulation-of-electricity means which is different from the accumulation-of-electricity means of the above 1st in the above-mentioned capacitor -- connecting -- this -- Accumulation-of-electricity equipment characterized by being constituted so that a switch in in the above 1st and the 2nd connection mode by this connection means for switching may be performed repeatedly.
[Claim 2] In the accumulation-of-electricity equipment which two or more accumulation-of-electricity means were connected to the serial, and was constituted The capacitor in which parallel connection is possible respectively for two or more above-mentioned accumulation-of-electricity means, An electrical-potential-difference monitor means to supervise each electrical potential difference of two or more above-mentioned accumulation-of-electricity means, the electrical-potential-difference monitor result of the above-mentioned electrical-potential-difference monitor means -- responding -- two accumulation-of-electricity means out of two or more above-mentioned accumulation-of-electricity means -- choosing -- the 1st accumulation-of-electricity means of these two accumulation-of-electricity means -- connecting -- this -- the 1st connection mode which performs charge or discharge of this capacitor through the 1st accumulation-of-electricity means -- and The connection means for switching which switches alternatively the 2nd connection mode which performs charge or discharge of this capacitor through the 2nd accumulation-of-electricity means is offered. the 2nd accumulation-of-electricity means which is different from the accumulation-of-electricity means of the above 1st in the above-mentioned capacitor -- connecting -- this -- Accumulation-of-electricity equipment characterized by being constituted so that a switch in in the above 1st and the 2nd connection mode by this connection means for switching may be performed repeatedly.
[Claim 3] The above-mentioned connection means for switching is accumulation-of-electricity equipment according to claim 2 characterized by choosing mutually two accumulation-of-electricity means by which an electrical-potential-difference difference is large, as the above 1st and 2nd accumulation-of-electricity means according to the electrical-potential-difference monitor result of the above-mentioned electrical-potential-difference monitor means.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] About the accumulation-of-electricity equipment which carried out series connection of many batteries, and was constituted as a group cell, especially, this invention is used for an electric vehicle and relates to suitable accumulation-of-electricity equipment.
[0002]
[Description of the Prior Art] Although ED for the improvement in practicality of an electric vehicle is furthered in recent years, as a power source of a current electric vehicle, what carried out series connection of many batteries (henceforth a dc-battery) (group cell) is used. Thus, since it depends for the output of a group cell on the cell of the lowest electrical potential difference in the case of the group cell which carried out series connection of many batteries, each cell cannot be used equally and capacity of each cell cannot be demonstrated to the maximum extent.
[0003] By the way, like a lithium ion battery, by what output voltage is determined as depending on the amount of discharge (refer to drawing 4), to be able to make equal the amount of discharge of each cell (if it says conversely a charge or remaining capacity) by making the electrical potential difference of each cell equal, and what is necessary is made just to charge, adjusting so that the electrical potential difference of each cell may become equal. Then, the electrical-potential-difference balancing circuit of a battery (dc-battery) is offered from the former, and it is constituted as shown in drawing 5 .
[0004] The circuit shown in drawing 5 extracts a part for one cel of the electrical-potential-difference balancing circuit of a group cell (a part for or one module), and each dc-battery is equipped with this circuit. And although charge actuation in the condition of having offered such a circuit is performed, discharge actuation by this circuit is performed in the last stage of charge actuation. That is, the electrical-potential-difference supervisory circuit (electrical-potential-difference detector) 104 is supervising this condition, and when the both-ends electrical potential difference VB of a cel becomes more than a programmed voltage, the discharge switch 102 is made to shift to an ON state (closed state), although the terminal voltage of a dc-battery 101 rises by advance of charge.
[0005] Thereby, energization to a discharging resistor 103 is performed and it is consumed by changing electrical energy into heat. If the cel electrical potential difference VB turns into an electrical potential difference below a programmed voltage by this consumption, making the discharge switch 102 shift to an OFF state (open condition) will be performed. The electrical potential difference VB of a dc-battery cel is adjusted to a programmed voltage by repeating ON of such a discharge switch 102, and OFF.
[0006] In addition, the approach of using power components, such as a power transistor, instead of the discharge switch 102, and not on-off control but linear control adjusting an electrical potential difference is common in an actual circuit.
[0007]
[Problem(s) to be Solved by the Invention] However, various technical problems occur with conventional accumulation-of-electricity equipment. That is, when calling at an above-mentioned circuit, the energy which exceeded the programmed voltage will be wasted in the form of heat by the discharging resistor 103. For this reason, while power

loss becomes large, that the cure against heat dissipation must be taken into consideration poses a big problem.

[0008] Moreover, the technical problem that balancing is possible only when the cel electrical potential difference VB of the last stage of charge rises, and electrical-potential-difference balancing using idle time while using neither the time of discharge nor a car etc. cannot be performed occurs. Therefore, it cannot use for what does not charge to a full charge like a hybrid electric vehicle at the time of generation-of-electrical-energy transit.

[0009] Furthermore, mass things, such as a discharging resistor, and a heat sink, a component for switching, must be used, and the technical problem that structures -- equipment is enlarged or a cooling system is needed for heat dissipation -- do not become simple also occurs. Then, the balancing circuit which is not a discharge method is required, and the technique of JP,6-319287,A is offered as the example.

[0010] Although this technique connects a capacitor to the both ends of the group cell by which the series connection was carried out and each dc-battery cel (charge cell) is charged at abbreviation homogeneity, a mass capacitor is required, and the control which chooses the dc-battery cel set as the necessary charge object has control logic complicated [detecting the terminal voltage of each dc-battery cel]. Then, each dc-battery and a corresponding number of capacitors are formed to the dc-battery connected to the serial, and it is possible to attain balancing of the electrical potential difference of each dc-battery switching by turns the 1st connection mode which carries out parallel connection of each capacitor to the corresponding dc-battery, respectively, and the 2nd connection mode which carries out parallel connection of each above-mentioned capacitor to the dc-battery contiguous to a corresponding dc-battery, respectively.

[0011] In this case, balancing of the electrical potential difference of each dc-battery is carried out by moving a charge between dc-batteries through a capacitor. However, with such a configuration, since a charge is movable only between adjacent dc-batteries, according to the number of cels of a dc-battery increasing, it is in balancing of an electrical potential difference in time amount or the technical problem that it will start. Moreover, since a capacitor is needed for every dc-battery cel, an electrical-potential-difference balancing circuit becomes large, and the technical problem that cost quantity is caused also occurs.

[0012] By the way, the technique which chooses the dc-battery cel to charge as the group cell which comes to carry out the series connection of two or more dc-battery cels while supervising the terminal voltage and the capacitor electrical potential difference of each dc-battery cel, in case it charges by the capacitor charged from the regeneration current is indicated by JP,6-319287,A. While making charge possible even if the electrical potential difference of a capacitor is falling by choosing a part from two or more dc-battery cels, and charging so that the total of the terminal voltage of a dc-battery cel which charges may become lower than a capacitor electrical potential difference, it enables it to charge two or more dc-battery cels by charging a dc-battery cel with low terminal voltage with this technique at homogeneity.

[0013] Although this technique can equalize the electrical potential difference of each dc-battery on the occasion of charge of a dc-battery, it cannot attain electrical-potential-difference balancing of a dc-battery other than the time of charge of a dc-battery. However, it is a technique available to electrical-potential-difference balancing of a

common dc-battery. This invention aims at offering the accumulation-of-electricity equipment which enabled it to perform balancing of the electrical potential difference of an accumulation-of-electricity means also in the condition that it is not a full charge, promptly moreover with the simple configuration which can control cost, having been originated in view of the above-mentioned technical problem, and preventing waste of electrical energy.

[0014]

[Means for Solving the Problem] for this reason, with the accumulation-of-electricity equipment of this invention according to claim 1 If a connection means for switching switches 1st connection mode and 2nd connection mode and the 1st connection mode is chosen If connect a capacitor to the 1st accumulation-of-electricity means of two or more accumulation-of-electricity means, charge or discharge of a capacitor is performed through this 1st accumulation-of-electricity means, the electrical potential difference of a capacitor and the electrical potential difference of the 1st accumulation-of-electricity means come to approach and the 2nd connection mode is chosen A capacitor is connected to the 2nd different accumulation-of-electricity means from the 1st accumulation-of-electricity means, charge or discharge of a capacitor is performed through this 2nd accumulation-of-electricity means, and the electrical potential difference of a capacitor and the electrical potential difference of the 2nd accumulation-of-electricity means come to approach. Therefore, if a switch in the 1st connection mode and the 2nd connection mode is performed repeatedly, balancing of the electrical potential difference is carried out by the connection means for switching through the capacitor between the 1st accumulation-of-electricity means and the 2nd accumulation-of-electricity means.

[0015] With the accumulation-of-electricity equipment of this invention according to claim 2, an electrical-potential-difference monitor means supervises each electrical potential difference of two or more accumulation-of-electricity means, and a connection means for switching chooses two accumulation-of-electricity means from two or more accumulation-of-electricity means according to the electrical-potential-difference monitor result of an electrical-potential-difference monitor means, and switches 1st connection mode and 2nd connection mode between these two accumulation-of-electricity means. If the 1st connection mode is chosen, will connect a capacitor to the 1st accumulation-of-electricity means of two or more accumulation-of-electricity means, and charge or discharge of a capacitor will be performed through this 1st accumulation-of-electricity means. If the electrical potential difference of a capacitor and the electrical potential difference of the 1st accumulation-of-electricity means come to approach and the 2nd connection mode is chosen A capacitor is connected to the 2nd different accumulation-of-electricity means from the 1st accumulation-of-electricity means, charge or discharge of a capacitor is performed through this 2nd accumulation-of-electricity means, and the electrical potential difference of a capacitor and the electrical potential difference of the 2nd accumulation-of-electricity means come to approach. Therefore, if a switch in the 1st connection mode and the 2nd connection mode is repeatedly performed by the connection means for switching, balancing of the electrical potential difference is carried out between the 1st accumulation-of-electricity means and the 2nd accumulation-of-electricity means which were chosen according to the electrical-potential-difference monitor result through the capacitor.

[0016] With the accumulation-of-electricity equipment of this invention according to

claim 3, a connection means for switching responds to the electrical-potential-difference monitor result of an electrical-potential-difference monitor means. Since two accumulation-of-electricity means by which an electrical-potential-difference difference is large are mutually chosen as 1st and 2nd accumulation-of-electricity means out of two or more accumulation-of-electricity means and balancing of an electrical potential difference is performed Balancing of the electrical potential difference of two accumulation-of-electricity means by which an electrical-potential-difference difference is large is carried out, and electrical-potential-difference balancing of two or more accumulation-of-electricity means is promoted by the repeat of such processing.

[0017]

[Embodiment of the Invention] Hereafter, with a drawing, when the gestalt of operation of this invention is explained, drawing 1 - drawing 4 show the accumulation-of-electricity equipment as 1 operation gestalt of this invention. As shown in drawing 1, it consists of these accumulation-of-electricity equipment as the battery (it is also called a dc-battery or a dc-battery cel a rechargeable battery and the following) B1 as two or more accumulation-of-electricity means, B-2, B3, B4, and a group cell by which ... was connected to the serial.

[0018] Especially the accumulation-of-electricity equipment of this operation gestalt can be applied to the group cell (= the cell which comes to connect two or more batteries) used as a power source for electric vehicles, and is constituted as a group cell which connected dozens of dc-batteries cel to the serial. In addition, although drawing 1 shows only the four dc-batteries cel on account of the drawing, the dc-battery cel of a large number which are not illustrated shall be connected further, and dozens of dc-batteries cel shall be connected to a serial in all.

[0019] However, with this accumulation-of-electricity equipment, especially the number of the dc-battery cels (accumulation-of-electricity means) which constitute a group cell is not limited. Every two switches are connected to each terminal of such a dc-battery cel (accumulation-of-electricity means) B1, B-2, B3, B4, and ..., respectively. That is, as shown in drawing 1 , one edge each of switches S11 and S12 is connected to the plus terminal side of the dc-battery cel B1. One edge each of switches S21 and S22 is connected to the minus terminal side (namely, plus terminal side of dc-battery cel B-2) of the dc-battery cel B1. One edge each of switches S31 and S32 is connected to the minus terminal side (namely, plus terminal side of the dc-battery cel B3) of dc-battery cel B-2. One edge each of switches S41 and S42 is connected to the minus terminal side (namely, plus terminal side of dc-battery cel B4) of the dc-battery cel B3. The switch is similarly connected about the terminal of the dc-battery cel which is not illustrated.

[0020] Such switches S11, S12-S41, S42, and ... All are on/off switches. Each other end of switches S11, S21, S31, and S41 and ... among switches S11, S12-S41, S42, and ... It connects with the end side of a capacitor (capacitor) C1, and each other end of switches S12, S22, S32, and S42 and ... is connected to the other end side of a capacitor C1. And in order to carry out on-off control of these switches S11, S12-S41, S42, and ..., the switch switching control 1 is offered.

[0021] Moreover, the dc-battery cel electrical-potential-difference monitor 2 as each dc-battery cel B1, B-2, B3, B4, and an electrical-potential-difference monitor means to supervise the terminal voltage of ... is offered, and each dc-battery cel B1 obtained by the monitor of this dc-battery cel electrical-potential-difference monitor 2, B-2, B3, B4, and

the terminal voltage information on ... are transmitted to the switch switching control 1.
[0022] By the switch switching control 1, although the switch of the arbitration in switches S11, S12-S41, S42, and ... can be connected, based on the electrical-potential-difference information from the dc-battery cel electrical-potential-difference monitor 2, switch change-over processing for carrying out balancing of the electrical potential difference is performed here between dc-battery cels and dc-battery cels with the lowest electrical potential difference with the highest electrical potential difference.
[0023] In the switch switching control 1, namely, by switch change-over processing First, after carrying out parallel connection of a dc-battery cel and a capacitor C1 with the highest electrical potential difference (such a connection condition is called 1st connection mode), next intercepting the parallel connection of this dc-battery cel and capacitor C1 with the highest electrical potential difference Parallel connection of a dc-battery cel and a capacitor C1 with the lowest electrical potential difference is carried out (such a connection condition is called 2nd connection mode), and the parallel connection of this dc-battery cel and capacitor C1 with the lowest electrical potential difference is intercepted after that.
[0024] in addition, the time of connecting each dc-battery cel to a capacitor C1 -- the plus terminal of each dc-battery cel -- the end side of a capacitor C1 -- the minus terminal of each dc-battery cel -- the other end side of a capacitor C1 -- as -- it comes out not to mention doubling the direction of a terminal and connecting. If such processing is performed, in the 1st connection mode, since a high electrical potential difference is applied to a capacitor C1, a lot of charges according to this high electrical potential difference are stored, in the 2nd connection mode, the electrical potential difference which joins a capacitor C1 will become lower than the 1st connection mode, and the charge according to deep sag will be transported to a dc-battery cel with the lowest electrical potential difference. Therefore, a charge is transported to a dc-battery cel with the lowest electrical potential difference from a dc-battery cel with the highest electrical potential difference by repeating the 1st connection mode and the 2nd connection mode, and balancing of an electrical potential difference is performed between these dc-batteries cels.
[0025] At the switch switching control 1 of this operation gestalt, a dc-battery cel with the highest electrical potential difference and a dc-battery cel with the lowest electrical potential difference are chosen with a predetermined period at the time. Carrying out parallel connection of the selected dc-battery cel to a capacitor C1 suitably, and performing 1st connection mode and 2nd connection mode among these dc-battery cels A charge is transported to a dc-battery cel with a low electrical potential difference from a dc-battery cel with a high electrical potential difference, and balancing of the electrical potential difference between dc-battery cels is performed.
[0026] In addition, within 1 period, you may constitute so that the 1st connection mode and the 2nd connection mode may be repeated predetermined [several], and you may constitute so that 1st connection mode and 2nd connection mode may be performed only once, respectively. Anyway, balancing of an electrical potential difference is performed by the parallel connection of the dc-battery cel and capacitor C1 by such 1st connection mode and the 2nd connection mode between a dc-battery cel with the highest electrical potential difference, and a dc-battery cel with the lowest electrical potential difference at the time.

[0027] In addition, although the switches S11, S12-S41 as a connection means for switching, S42, and ... may be constituted from mechanical switches S11-S14, if a controllability and endurance are taken into consideration, it is possible [it] to constitute by the semi-conductor means for switching (solid state switch) by semiconductor devices, such as a transistor. Since the accumulation-of-electricity equipment as 1 operation gestalt of this invention is constituted as mentioned above, the following actuation is performed.

[0028] That is, in the switch switching control 1, based on the electrical-potential-difference information from the dc-battery cel electrical-potential-difference monitor 2 as an electrical-potential-difference monitor means, a dc-battery cel with the highest electrical potential difference and a dc-battery cel with the lowest electrical potential difference are periodically chosen from two or more dc-battery cels, and switch change-over processing for carrying out balancing of the electrical potential difference is performed among these dc-battery cels and dc-battery cels with the lowest electrical potential difference with the highest electrical potential difference.

[0029] A certain processing period, the electrical potential difference V1 of an electrical potential difference of the dc-battery cel B1 is the highest. The electrical potential difference V3 (V1<V3) of the dc-battery cel B3 for example, when an electrical potential difference is the lowest First, as shown in drawing 2 , while changing a switch S11 and a switch S22 into an ON (connection) condition and connecting the plus side edge child of a dc-battery B1 to the end side (the drawing 1 and drawing 2 side, terminal side of the lower part of ** in drawing 3) of a capacitor C1 The minus side edge child of a dc-battery B1 is connected to the other end side (the drawing 1 and drawing 2 side, terminal side above ** in drawing 3) of a capacitor C1 (1st connection mode).

[0030] Like this 1st connection mode, if parallel connection of a capacitor C1 and the dc-battery cel B1 is carried out, each of electrical potential differences of the dc-battery cel B1 and potential difference of a capacitor C1 will become V1'. This V1' is an electrical potential difference (=V1-v1) only with the part v1 lower than V1 according to the charge which flowed into the capacitor C1 from the dc-battery cel B1. Next, as shown in drawing 1 , after returning a switch S11 and a switch S22 to an OFF (cutoff) condition, as shown in drawing 3 While changing a switch S31 and a switch S42 into an ON (connection) condition and connecting the plus side edge child of a dc-battery B3 to the end side of a capacitor C1, the minus side edge child of a dc-battery B3 is connected to the other end side of a capacitor C1 (2nd connection mode).

[0031] Like this 2nd connection mode, if parallel connection of a capacitor C1 and the dc-battery cel B3 is carried out, the electrical potential difference of the dc-battery cel B3 and the potential difference of a capacitor C1 will become V3', respectively. This V3' is an electrical potential difference by the charge v3 which flowed into the capacitor C1 from the dc-battery cel B3 higher than V3 (=V3+v3). Moreover, also at the time of termination in the 2nd connection mode, as shown in drawing 1 , a switch S31 and a switch S42 are returned to an OFF (cutoff) condition.

[0032] Thus, through a capacitor C1, a charge is transported to the dc-battery cel B3 from the dc-battery cel B1, the electrical potential difference of the dc-battery cel B1 decreases from V1, the electrical potential difference of the dc-battery cel B3 increases from V3, and the electrical-potential-difference difference of these dc-battery cels B1 and dc-battery cels B3 decreases. Between such the dc-battery cels B1 and the dc-battery cels B3,

if switch control by the 1st connection mode and switch control by the 2nd connection mode are performed only the count of predetermined, or once, it will move to the following processing period and a dc-battery cel with the highest electrical potential difference and a dc-battery cel with the lowest electrical potential difference will be again chosen from two or more dc-battery cels by the switch switching control 1 based on the electrical-potential-difference information from the dc-battery cel electrical-potential-difference monitor 2.

[0033] Although the electrical potential difference of the dc-battery cel B1 decreases and the electrical potential difference of the dc-battery cel B3 is increasing here Although the dc-battery cel B1 may be chosen as a dc-battery cel with the highest electrical potential difference or the dc-battery cel B3 may be chosen as a dc-battery cel with the lowest electrical potential difference if there are little an increment and reduction of these electrical potential differences At least, compared with the last processing period, the electrical potential difference of a dc-battery cel with the highest electrical potential difference is low, and the electrical potential difference of a dc-battery cel with the lowest electrical potential difference is high.

[0034] And balancing of the electrical potential difference between these dc-battery cels is performed by performing switch control by the 1st connection mode, and switch control by the 2nd connection mode only the count of predetermined, or once like **** between the dc-battery cels and the dc-battery cels with the lowest electrical potential difference with the highest electrical potential difference which were newly chosen. Consequently, too, compared with the last processing period, the electrical potential difference of a dc-battery cel with the highest electrical potential difference becomes low, and the electrical potential difference of a dc-battery cel with the lowest electrical potential difference becomes high.

[0035] By repeating such processing, balancing of the electrical potential difference between two or more dc-battery cels comes to be performed efficiently, and balancing of the electrical potential difference comes to be promptly carried out in two or more dc-battery cels. In order to perform promptly migration of a charge to a capacitor C1 from a dc-battery cel and to perform electrical-potential-difference balancing by migration of the charge between two dc-battery cels especially for a short time so that the electrical-potential-difference difference between two dc-battery cels is large, balancing of an electrical potential difference is performed efficiently.

[0036] In addition, with an above-mentioned operation gestalt, as simpleest example, although electrical-potential-difference balancing between two dc-battery cels of a dc-battery cel with the highest electrical potential difference and a dc-battery cel with the lowest electrical potential difference shall be performed each processing period, it may be made to perform electrical-potential-difference balancing between the dc-battery cels of three or more a large number to coincidence. For example, the average electrical potential difference of all dc-battery cels is computed, and an electrical potential difference can consider it that an electrical potential difference consists of this average electrical potential difference beyond a predetermined electrical-potential-difference difference between low dc-battery cel groups (an unit or two or more dc-battery cels) so that electrical-potential-difference balancing may be performed to coincidence to be a high dc-battery cel group (an unit or two or more dc-battery cels) beyond a predetermined electrical-potential-difference difference rather than this average electrical potential

difference.
[0037] First, parallel connection of each dc-battery cel of a high dc-battery cel group is carried out to a capacitor C1 beyond a predetermined electrical-potential-difference difference [electrical potential difference / average] at coincidence (1st connection mode), and a capacitor C1 is charged. In this case, subsequently Parallel connection of each dc-battery cel of a low dc-battery cel group is carried out to a capacitor C1 beyond a predetermined electrical-potential-difference difference at coincidence (2nd connection mode), and it is made to discharge from a capacitor C1 to each dc-battery cel with a low electrical potential difference rather than an average electrical potential difference, after canceling these connection. There is an advantage which a charge can move to each dc-battery cel with a low electrical potential difference from each dc-battery cel with a high electrical potential difference by this, can perform electrical-potential-difference balancing to coincidence among many (three or more pieces) dc-battery cels, and can perform electrical-potential-difference balancing more promptly among many dc-battery cels.
[0038] Moreover, if it sets up so that electrical-potential-difference balancing processing may be ended when any electrical potential difference of a dc-battery cel becomes within a predetermined electrical-potential-difference difference (minute value) to this average electrical potential difference to the average electrical potential difference of all dc-battery cels, electrical-potential-difference balancing processing can be performed more efficiently. Of course, if the electrical potential difference of one of dc-battery cels becomes to an average electrical potential difference beyond a predetermined electrical-potential-difference difference (minute value) while using the battery further, what is necessary is just made to perform electrical-potential-difference balancing processing between the dc-battery cels which have an electrical-potential-difference difference most, for example.
[0039] Thus, with this accumulation-of-electricity equipment, since the thing of arbitration can be chosen from many dc-battery cels (charge means), this can be connected to a capacitor and electrical-potential-difference balancing processing can be performed, if a dc-battery cel is chosen appropriately and electrical-potential-difference balancing processing is carried out, electrical-potential-difference balancing processing can be performed very efficiently. Moreover, since charge transfer components require only one balance capacitor C1, a circuit can be constituted small and there is also an advantage which can also reduce cost.
[0040] By the way, the battery concerning this accumulation-of-electricity equipment is formed with the lithium ion battery, and an electrical potential difference is determined like the property of the lithium ion battery shown in drawing 4 depending on the amount of discharge. Conversely, if it says, it can be said that battery voltage is determined depending on a charge (the amount of accumulation of electricity). Therefore, it will be adjusted in the condition of the desired amount of discharge, i.e., a charge, (the amount of accumulation of electricity) by balancing of this electrical potential difference.
[0041] in addition, by the battery of the flat property that an electrical potential difference does not become settled uniquely to the amount of discharge, like the property of the nickel hydoride battery shown in drawing 4 Although the amount of discharge (charge) will not be in a desired condition by balancing of an electrical potential difference, in that by which an electrical potential difference becomes settled uniquely to the amount of

discharge like the above-mentioned lithium ion battery Since the amount of discharge of each dc-battery cel of a group cell (charge) is equalized by the desired condition, the engine performance of this cell (for example, lithium ion battery) can be utilized for full.
[0042] Of course, with this equipment, in order to carry out balancing of each dc-battery cel B1, B-2, B3, B4, and the electrical potential difference of ... by moving a charge through a capacitor C1, a big exoergic element does not exist but balancing in the condition of having avoided the energy loss by generation of heat is realized. Moreover, since balancing can be operated in all the condition, without being caught by operating conditions, such as not only under charge to the full charge to a group cell but under transit, charge, and discharge etc., balancing can be operated also in the inside of discharge, the time of cell intact, etc. Of course, it can use also for what does not charge to a full charge like a hybrid electric vehicle at the time of generation-of-electrical-energy transit.
[0043] In addition, although it is needed that it is efficient, actuation is trustworthy and endurance is good in actually applying such a circuit If such concrete conditions are taken into consideration, what has switching losses small as much as possible to switches S11, S12, S21, and S22 and ..., such as a power component (FET or IGBT), will be used. It is desirable to equip the circuit which makes switches S11, S12, S21, and S22 and switch actuation of ... perform to the switch switching control 1 automatically by an external oscillator circuit etc.
[0044] Moreover, if a capacitor with a comparatively big capacity, for example, an electric double layer capacitor, is used for a capacitor C1, balancing of a prompt electrical potential difference can be performed, but if it is made to perform balancing control of always or such an electrical potential difference frequently, for example, even if it uses the capacitor of small capacity, balancing of the charge by balancing of an electrical potential difference can fully be performed practically. Furthermore, the prevention circuit and initial charge circuit of the rush current to a capacitor C1 are also considered to be the need.
[0045] About the switch switching control 1, moreover, in addition to actuation of the above switch switches Make it interlock the maintenance switch used when maintaining, each switches S11, S12, S21, and S22, and ..., or The approach of driving, when the need arises by an external amplitude-measurement circuit etc., Electrical-potential-difference balancing processing (processing which chooses each switches S11, S12, S21, and S22 and ..., and is connected suitably) The approach of being made to perform at the time of car un-using it, the approach of performing for every fixed time amount in a timer circuit etc., the control circuit of the electric load connected (in the case of an electric vehicle), etc. Various combination, such as the approach of performing, when the balancing directions from a motor controller, a remaining capacity meter, etc. are received, can be considered.
[0046] Furthermore, even if it replaces with the capacitor C1 as a capacitor and uses an isolation transformer and a dc-battery cel, the almost same effectiveness can be acquired. Moreover, this accumulation-of-electricity equipment can be applied also to the group capacitor which replaces with a dc-battery as an accumulation-of-electricity means, and used the capacitor (capacitor). That is, replacing with the group cell which consists of two or more batteries (dc-battery) by which the series connection was carried out, and applying to the group capacitor which consists of two or more capacitors (capacitor) by

which the series connection was carried out is also considered.
[0047] And if the various faults by dispersion in a cel electrical potential difference adopt above-mentioned structure about a dc-battery, an electric double layer capacitor, etc. which are easy to make it remarkable and constitute an electrical-potential-difference balancing circuit when it changes into a group cell condition or a group capacitor condition, the system which can always perform balancing of an electrical potential difference without generating of big energy loss can be realized. The approach of carrying out balancing of the electrical potential difference for actuation of this circuit at the required stage of arbitration with a dc-battery [not always but] cel electrical-potential-difference monitor etc. can be embodied.
[0048] The reservation of safety after pulling out the capacity of a lithium ion battery 100% becomes easy by applying this circuit to a lithium ion battery especially. In addition, the duration of electrical-potential-difference balancing can also be shortened by changing the rate of the connection mode switch by the control means as it shifts, when it becomes small from from when the imbalance of a cel electrical potential difference is large.
[0049]
[Effect of the Invention] As explained in full detail above, according to the accumulation-of-electricity equipment of this invention according to claim 1, by the connection means for switching If a switch in the 1st connection mode and the 2nd connection mode is performed repeatedly, since balancing of the electrical potential difference is carried out through the capacitor between the 1st accumulation-of-electricity means and the 2nd accumulation-of-electricity means, Without it seeming that a part for an imbalance electrical potential difference is made to waste by the power consumption by heat dissipation, there is an advantage which can perform electrical-potential-difference balancing controlling power loss, and the capacity as a group cell can be demonstrated efficiently. Moreover, the additional advantage that the cure against heat dissipation can be mitigation-ized by reduction of a heat loss can also be acquired. Of course, there is an advantage which can perform balancing of an electrical potential difference now, without being caught by operating conditions, such as under transit, charge, and discharge.
[0050] If a switch in the 1st connection mode and the 2nd connection mode is repeatedly performed by the connection means for switching according to the accumulation-of-electricity equipment of this invention according to claim 2 Since balancing of the electrical potential difference is carried out between the 1st accumulation-of-electricity means and the 2nd accumulation-of-electricity means which were chosen according to the electrical-potential-difference monitor result through the capacitor, According to an electrical-potential-difference condition, the high accumulation-of-electricity means of whenever [demand / of balancing] can be chosen, balancing of an electrical potential difference can be efficiently performed now promptly, and the capacity as a group cell can be efficiently demonstrated now. Of course, there is also an advantage which can perform balancing of an electrical potential difference now, without being caught by operating conditions, such as the advantage which can perform electrical-potential-difference balancing, the additional advantage that the cure against heat dissipation can be mitigation-ized by reduction of a heat loss, and under transit, charge, and discharge, controlling power loss without it seeming that a part for an imbalance electrical potential difference is made to waste by the power consumption by heat dissipation.

[0051] According to the accumulation-of-electricity equipment of this invention according to claim 3, balancing of an electrical potential difference can be efficiently advanced from the large accumulation-of-electricity means of an electrical-potential-difference difference, balancing of the electrical potential difference in two or more accumulation-of-electricity means can be performed promptly, and the capacity as a group cell can be promptly demonstrated now efficiently.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the circuit diagram showing the important section configuration of the accumulation-of-electricity equipment as 1 operation gestalt of this invention.
[Drawing 2] It is a circuit diagram corresponding to drawing 1 for explaining actuation of the accumulation-of-electricity equipment as 1 operation gestalt of this invention, and drawing 1 is drawing showing a different mode of operation.
[Drawing 3] It is a circuit diagram corresponding to drawing 1 for explaining actuation of the accumulation-of-electricity equipment as 1 operation gestalt of this invention, and drawing 2 , and drawing 1 and drawing 2 are drawings showing a different mode of operation.
[Drawing 4]It is the graph which shows the property of the cell in the accumulation-of-electricity equipment as 1 operation gestalt of this invention.
[Drawing 5] It is the typical circuit diagram showing conventional accumulation-of-electricity equipment.
[Description of Notations]
1 Switch Switching Control
2 Dc-battery Cel Electrical-Potential-Difference Monitor as an Electrical-Potential-Difference Monitor Means
B1 - B4 Dc-battery cel which constitutes the battery (rechargeable battery) as an accumulation-of-electricity means
C1-C4 Capacitor (capacitor)
S11-S41, S12-S42 Switch as a connection means for switching

DRAWINGS

[Drawing 1]

[Drawing 2]

[Drawing 3]

[Drawing 4]

[Drawing 5]

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